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Decadal Assessment and Outlook Report on AMO 2020

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Final Technical Report: “Manipulating Quantum Systems: An Assessment of Atomic, Molecular, and Optical Physics in the United States”

Accomplishments

Research Objectives:

Goals for this project were to produce a report that (1) displays AMO science as a vital field that relates and unifies broad scientific endeavors; (2) discusses how AMO is supplying these and other fields with emerging technologies and fulfilling national needs; (3) identifies new opportunities, compelling scientific questions, and themes that have arisen from recent advances and accomplishments in the AMO field; (4) explains how AMO science meets workforce, educational, and other societal needs; and (5) makes recommendations for a strategy to fully realize the potential at the frontiers of AMO science.

The report also took a forward-looking perspective on how the elements that constitute AMO science provide a broad interdisciplinary driver for capitalizing on future opportunities in the scientific community. The survey was composed in a style accessible to the non-scientist reader to understand how AMO science will lead the way in these fields, what AMO researchers want to learn in the coming decades, and why. The report also compared the trajectory of AMO science in the US in the context of the international community of AMO science in terms of cooperation, collaboration, and competition.

Details of accomplishments during this reporting period.

During this study, a committee of 16 members came together to produce a peer-reviewed ~240-page report after hearing from the community through invited talks, a white paper call, and well-attended town halls at two AMO-related professional society meetings (i.e., APS-DAMOP and OSA). After being discussed with the sponsors in pre-public release briefings, the report is now publicly available on nas.edu/amo and printed copies are available.

How results were disseminated to communities of interest

A public report release webinar occurred on Dec 11, 2019, and the report was made public on the same day. All public study materials have been available throughout the project at nas.edu/amo.

Impacts

Please only report in the categories that are relevant to your project.

Development of the principal discipline(s) of the project

As stated in its statement of task, one intention of this decadal report is to impact “how the U.S. research enterprise might realize the full potential of AMO science.” This includes highlights of and program balance guidance for new science trends, such as those in quantum information science, but also in other areas of AMO research, such as ultrafast, ultracold, and precision measurement science.

Other disciplines

A chapter on the “Broader Impact of AMO” (chapter seven) is included in the report. AMO science provides enabling capabilities to other areas of scientific and technological development. (These areas range from fundamental physics to other subdisciplines within physics, as well as to chemistry, biology, and material science, to advanced manufacturing and engineering, and workforce training and industrial partnership.) AMO science also has both known and unexplored applications to biological systems, astrophysics, plasma, nuclear, and high-energy physics, and astrophysics, plasma, nuclear, and high-energy physics, and quantum and classical information technologies. The report suggests nurturing these connections and those with industry while not losing focus on the core missions of AMO science.

Describe the impact of this reporting period on the development of human resources

Hiring related to AMO researchers is explicitly highlighted as part of two recommendations. The first is a key recommendation to “enable and encourage cross-disciplinary hiring of theorists and experimentalists at the rapidly growing interface between AMO science fields” in chapter one. The second focuses on the hiring of theoretical AMO researchers in chapter eight. Other recommendations related to hiring in chapter seven (on the preparations of post-doctoral fellows) and chapter eight (e.g., possible fellowship grant models, inclusive work environments, and tapping into the growing talent pool) are also discussed.

Changes

Nothing to report.

Technical Updates

Nothing to report.